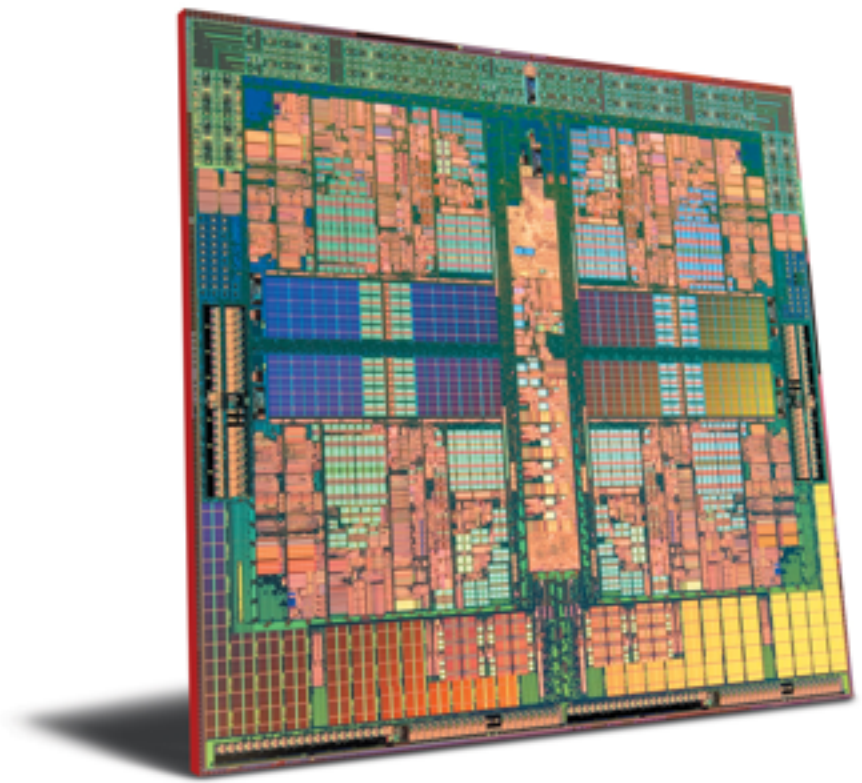
Kinetic Energy

Humans
move things

moving rocks



moving
electrons

To get things moving, we need to exert a force.

Newton's second law:

Force = mass * acceleration (F = ma)

so also

acceleration = force / mass

SI Units:

1 Newton force = 1 kg mass * 1 m/s/s acceleration

Other units:

· "Lbs" or "pounds mass" is mass in English measure (also, "slugs"!)

· "Pounds force" is force in English measure

From the google (you can type in equations and google handles the units):

(1 kg) * 1 ((meter / second) / second) = 1 newton

This leads to definitions for energy and work in physics:

Work is done when a force is applied through a distance.
Energy is the **capacity for doing work.** So:

Energy = force * distance

SI Units:
1 Joule energy = 1 Newton force * 1 Meter distance

(Since a newton is a unit of force, and F=ma, we can reduce this to:

1 joule = kg * 1 m / s / s * 1 m)

(1 newton) * 1 meter = 1 joule

((1 kg) * (1 (m^2))) / (1 (s^2)) = 1 joule

Power is the rate of work.

Power = Energy / Time

SI Units:
1 Watt power = 1 Joule energy / 1 second time
so also
1 Joule = 1 Watt * 1 second

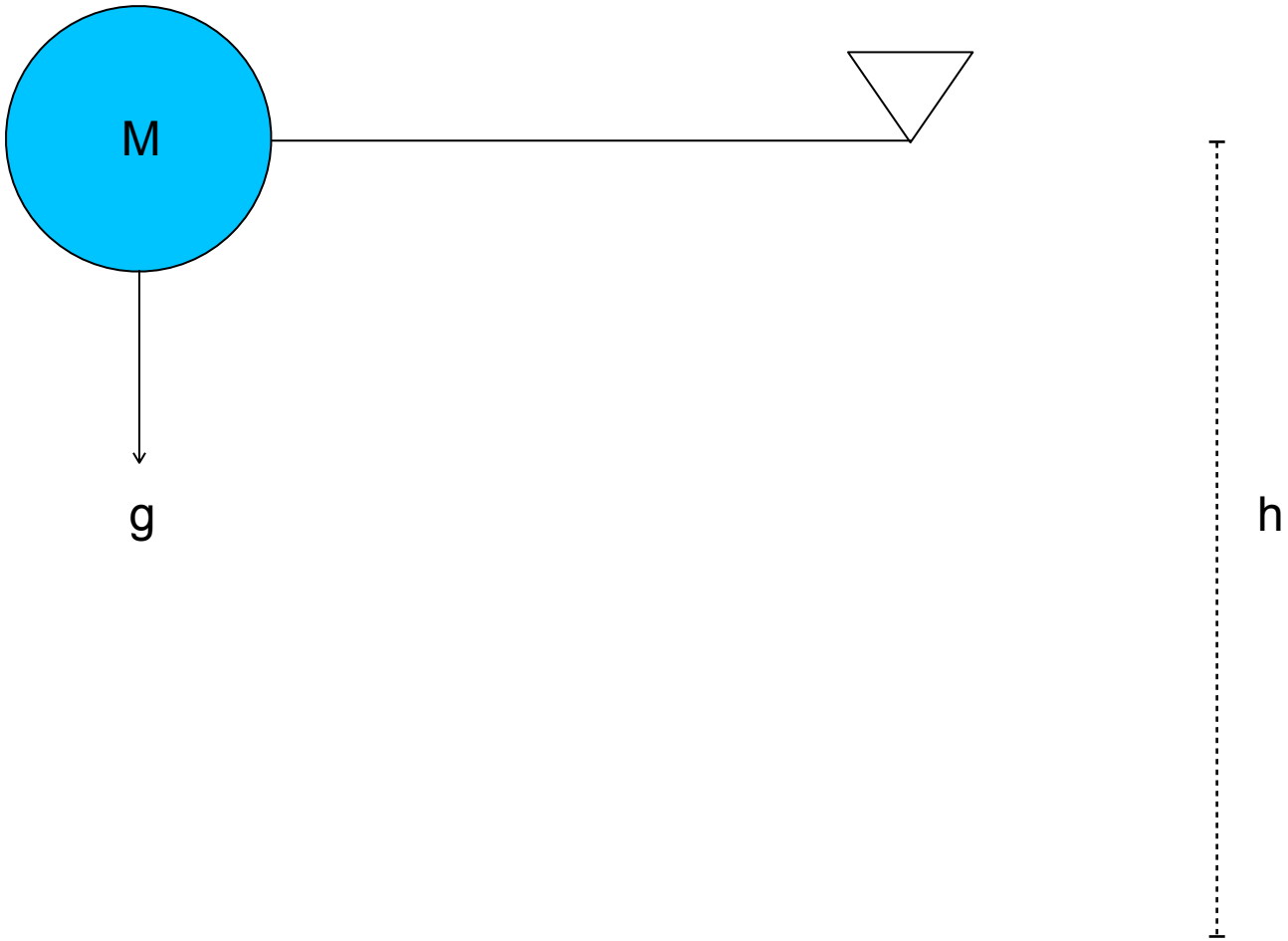
(1 joule) / (1 second) = 1 watt

We can perform work against the force of gravity to store energy in the position of objects in a gravitational field.

Gravitational Potential Energy = mgh

m = mass
g = gravitational acceleration = 9.8 m/s/s
h = height

(1 kg) * (9.8 ((m / s) / s)) * (1 meter) = 9.8 joules



$$PE = mgh$$

Kinetic energy is the energy of objects in motion:

Kinetic Energy = ½ mv2

m = mass in kg
v = velocity in meters/second

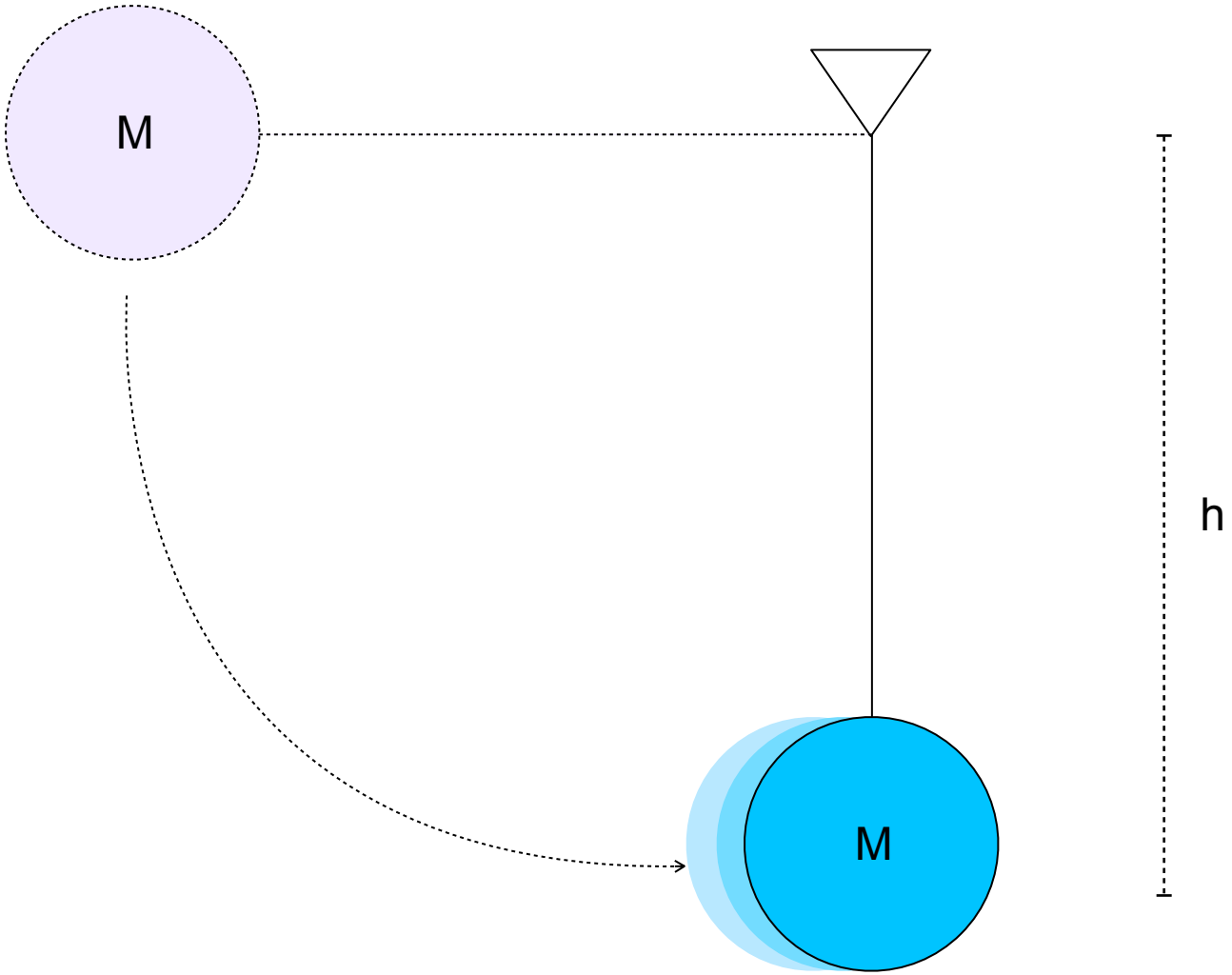
(1 / 2) * (1 kg) * ((1 (m / s))^2) = 0.5 joules

Rotational Work

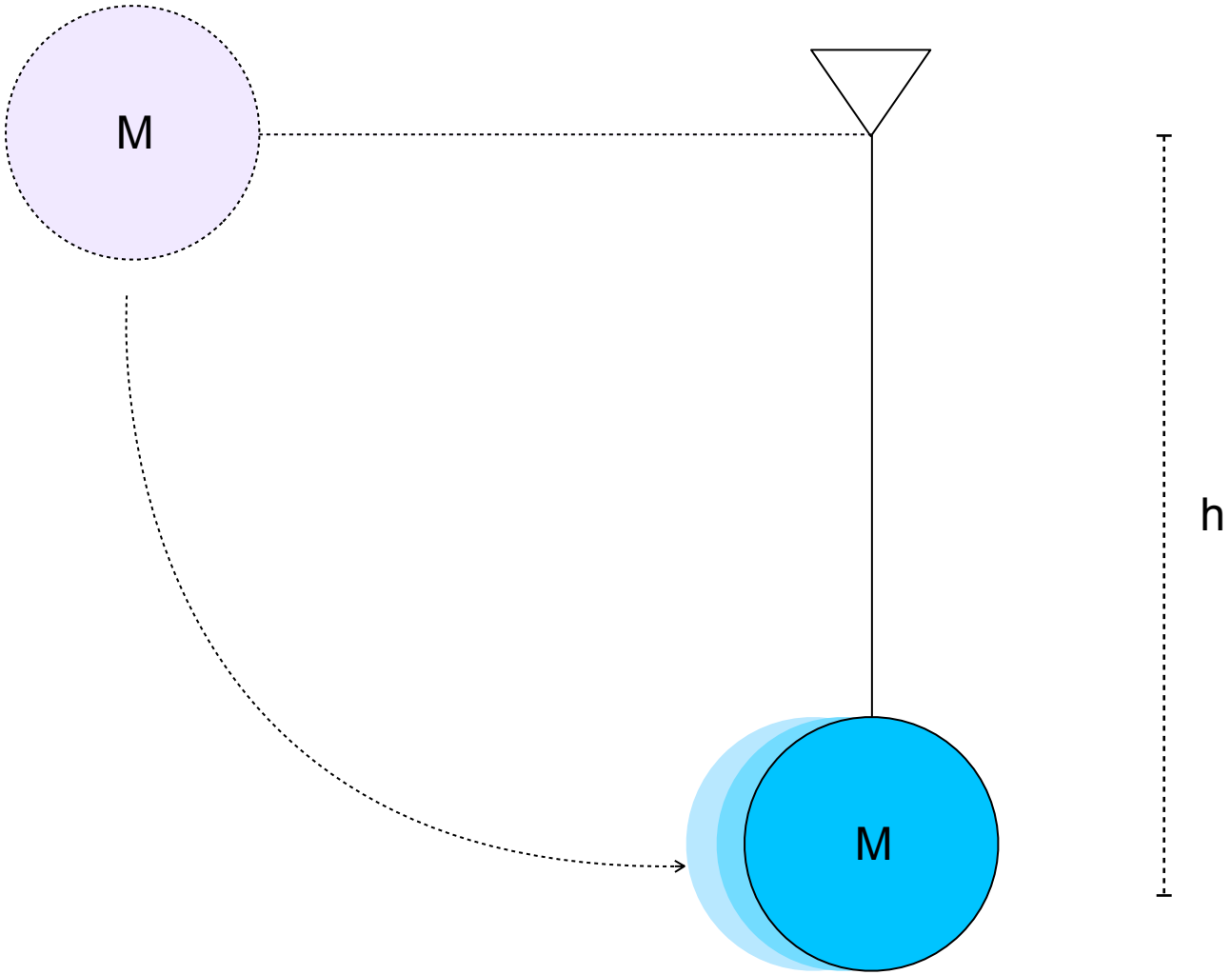
Same as linear work, but the force is traveling in a circle.

So 1 Newton force applied to a 1 meter lever pushed through 360 degrees = 6.28 Joules (The force moves through the circumference of the circle = 2 pi meters)

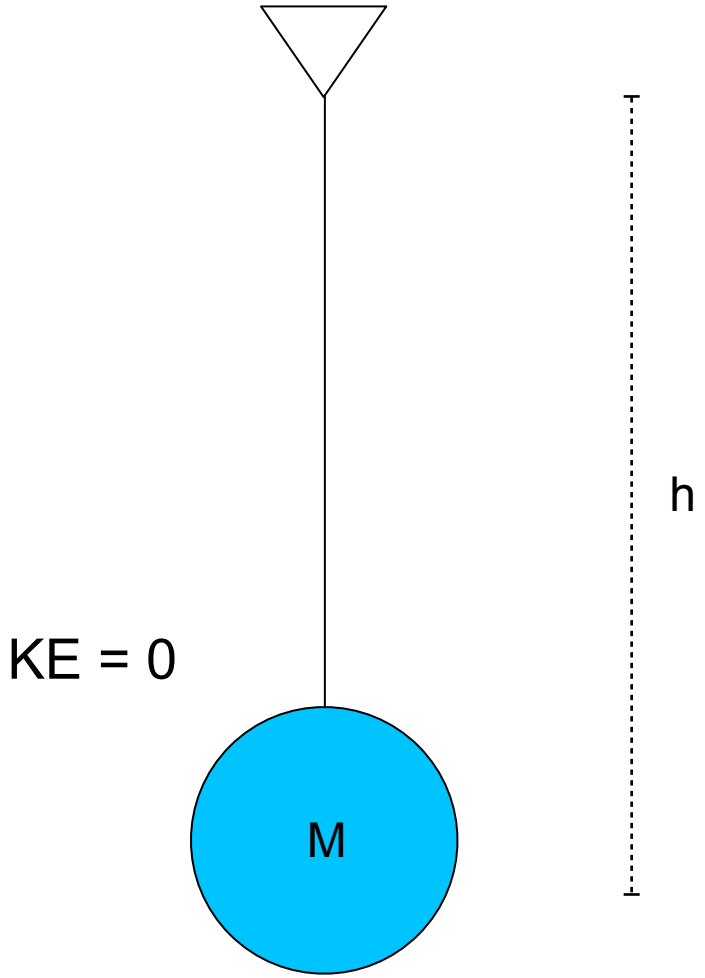
(1 newton) * 1 meter * (360 degrees) = 6.28318531 joules



$KE = \frac{1}{2} mv2$



On first swing, from 1st Law we know:
KE ~= PE (energy is conserved)



At end, we note 1st and 2nd laws. All of the original PE is *somewhere* (heat, noise, etc.), but is more diffuse and less useful to us.